Another species in which there is more than one ploidy level is *S. scouleri* Hook. The three tetraploid collections are widely separated geographically and include the robust coastal subsp. *grandis* (Eastw.) H. & M. from California. The two from Washington are probably referable to subsp. *typica* H. & M., although the collection from the Tacoma Prairies is suggestive of the stature and flower color of subsp. *grandis*. The octoploid forms of subsp. *typica* were from ecologically similar and geographically adjacent areas, separated from one another by the Snake River Canyon. The third subspecies of *S. scouleri*—subsp. *pringlei*—the pentaploid with $2n = 60$ has already been referred to in connection with its irregular meiotic behavior. It is a well-defined taxon with more remote affinities with *S. scouleri* than any others of the subspecies in this polymorphic species. Interfertility studies, now in progress, involving hybridizations between subsp. *pringlei* and subsp. *typica*, as well as among other related taxa, may clarify the systematic position of this puzzling entity.

The present observations on chromosome number in North American species of *Silene* have disclosed the existence of a polyploid seriation ranging from $2n = 24$ to $2n = 96$. When more cytological data as well as observations on interfertility are available for the balance of the North American species, it is hoped that inferences of relationship within the genus may be drawn with greater certainty than they have been in the past.

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A DEPHLOGISTICATED SPECIES CONCEPT

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Some two hundred fifty years ago in the field of chemistry there was considerable discussion as to the reality, the nature and attributes of "phlogiston", the essence of combustion. For many years, there has been no question as to the reality of this element which produced fire. Since many substances were combustible, it was obvious to the early workers that these materials contained phlogiston. Once such combustibles had been burned, thereby removing the pholgiston, they would no longer burn. They were dephlogisticated.

Acceptance of the phlogiston theory, however, brought problems. For example, charcoal was burned completely and must therefore have been

pure phlogiston. However, sulphur was also completely consumed on burn-
ing and must also be pure phlogiston. Yet sulphur and charcoal were obvi-
ously not the same substance. Then, too, both charcoal and sulphur could
be weighed, and if the end products of combustion were collected and
weighed, these end products weighed more than the original materials.
Since, presumably, phlogiston had been removed, then phlogiston must
have a negative weight. Yet the pure phlogiston, in either charcoal or
sulphur, had had a positive weight!

Such arguments, which may appear absurd to us now, finally succumbed
to a re-evaluation of the facts of combustion.

The term *species* today is in a somewhat similar position to that of
phlogiston two and a half centuries ago. There are today many discus-
sions concerning species, their delimitation, attributes and definition, and
these discussions often savour faintly of the arguments in favor of either
charcoal or sulphur being pure phlogiston. The reality of the species as a
biological or physical unit is probably only as valid as the reality of phol-
giston as a chemical unit or element. Perhaps it is time that we, like the
chemists of the past, re-examine the factual bases upon which our con-
cepts rest. Such a re-examination is attempted here.

It is not our intention to discard the term *species,* nor yet to offer an-
other definition to the multitude already in existence. It is instead, to
attempt to reach some common ground of agreement based upon a founda-
tion of fact. As we are now finding, without such common agreement,
the term species will be vague and meaningless and will lead ultimately
to confusion.

As we examine the various definitions of species which have been pro-
posed, the sole feature that appears to be common to all is the statement
that species are composed of individuals which possess certain common
characteristics. The nature of these common characteristics varies with
the different definitions. It should therefore be possible to start at this
level of agreement in the development of our thesis, namely, that each
species is composed of a number of individuals.

In nature, the question of individuality may arise in such forms as
Volvox, where the problem concerns a choice between considering the
sphere as a colony of individual cells or as a single individual organism.
The question may also arise in the lichens, where the problem concerns
the choice between dealing with the lichen as a single organism or as a
symbiotic relationship between an alga and a fungus. Normally, however,
in the higher plants, despite the common occurrence of symbionts and
parasites, there is no question as to the individuality of a plant. This
recognition of individuality is an inherent part of the various species defi-
nitions, so that we are not here implying anything novel. For this reason,
we may accept the occurrence of individual plants as the basis for taxon-
omy and classification in this group.

Since classification implies the sorting into classes, any classification of plants must attempt to separate the total mass of plants into groups. This total mass of plants includes all plants of all time, living and fossil, as well as those which have left no trace of their existence. If we had access to this total mass of plants, and if we accept the theory of evolution, it is obvious that we would be faced with a single continuum. It is also obvious that any classification of such a continuum would have to be based upon arbitrary standards, since at some point we would be forced to separate parent from offspring as belonging to different groups.

As classifiers, we should therefore be extremely thankful for the occurrence of extinction, because in dealing with contemporary plants, the extinction of the intervening individuals creates a gap in the continuum. When we attempt to portray the conditions found in nature in our system of classification, we utilize these gaps in the continuum as convenient places to draw a line of separation between groups of individuals. In palaeontology as well, the absence of certain intermediate fossil types also serves as a convenient gap for classification purposes.

Extinction is not a phenomenon of the past alone, but is also in operation today. As this is written, in some plant fertilization is occurring which will result in an embryo predestined for death or extinction before completion of its life cycle due to the physiology of the plant embryo being inadequate at some phase of its ontogeny. This inadequacy of the physiology is due in turn to the inadequacy of the genic complement of the zygote for the environment in which the embryo or seedling finds itself. As a corollary, each plant which lives to complete its life cycle obviously possesses a genic constitution adequate for the environment in which it lives. The environment selects for survival only those individuals with favorable gene combinations, and dooms the vast majority of the offspring to perish. If this were not true, we would soon be overpopulated with a given type of plant. Selection by the environment eliminates certain gene combinations and thereby produces discontinuities. These discontinuities involve a basic discontinuity in the total gene constitution.

Since it would be quite irrational to attempt to determine the total gene constitution of all individuals, we attempt to approximate this objective by determining the discontinuities in the distribution of characters which are controlled by genes. Since genes apparently control the physiology of the individual, and through the physiology both the morphology and the reactions of the individual to the environment, it would appear that discontinuity in the distribution of any character would serve as an indication of genic discontinuity.

It is possible to find in nature chromosomal translocations and inversions which produce genetic discontinuity. That is, individuals carrying these chromosomal aberrations show a great reduction in fertility when crossed with individuals carrying the normal chromosome complement. This may occur, however, when the total gene constitutions of the interbreeding individuals are practically identical. Hence such intersterility

cannot be used as an infallible measure of genic dissimilarity. Although individuals with mutually exclusive gene patterns are also intersterile, there is absolutely no assurance that a mere reduction in fertility is accompanied by a corresponding diversity of genic constitution. Intersterility in itself is an indication of a difference of physiology of the gametes involved, and may be of major or minor nature. It is of comparable importance to other physiological differences, such as those which may concern environmental relations.

If we include geographical and temporal distribution, discontinuities are of universal occurrence in nature, since no two individuals can occupy the same space at the same time. We are capable of bridging many of these discontinuities mentally. In fact, we frequently do so unconsciously, and then have a difficult time in appreciating the existence of the discontinuity. For example, when we encounter a patch of violets in the woods, we are apt to think of it in terms of a unit. We mentally group the similar individuals together into a single unit, despite the fact that the only units present are the individual plants. Their geographical proximity is purely relative to their proximity to each other as compared with the distance of the members to plants in other patches. Even the phylogenetic continuum mentioned earlier is more apparent than real since the offspring of sexually-reproducing parents is not the same organism as either parent. Thus the phylogenetic lineage is a series of descendant individuals which we see as a continuum only through our mental processes.

The tendency to speak and think in terms of attributes of a group of individuals, apart from the attributes of the individual components, is another example of mental aggregation or mental perception. As an example, one can readily see the triangle formed by setting up ten pins in a bowling alley, yet the triangle is not an attribute of any single pin, but rather of the whole group of pins. The triangle in this case is purely mental. *We* mentally construct three lines bounding the pins and we mentally produce them until they meet to form the triangle. In the same manner, we tend to bound a "grove" of trees, by drawing a mental line around the outermost trees. When the distance between two groves approximates the distance between the trees within the groves, then the process of drawing the boundaries becomes more difficult. Basically, of course, there is no doubt that there is a given number of trees, each in its own location. Whether they form one grove or two can be debated indefinitely and to no purpose.

Thus it would appear that all aggregation of individuals into groups is therefore a process of lesser or greater mental difficulty. In many cases, where a number of individual plants possess a combination of many characters which is unknown in other plant groups, the aggregation into a unit is mentally very simple. The fact that the combination of characters is unknown elsewhere implies discontinuity in the distribution of these characters. The greater the number of these characters, the easier is our mental aggregation of the individuals possessing them. We have, on the

other hand, groups of plants in which there are few common characters, and here the mental process of aggregation becomes increasingly difficult as the number of common characters is reduced.

It is logical, therefore, that as we progress through the aggregation process, from parent and offspring, through population, form, variety, species, genus, family, order, and class, there will be progressively fewer common characters held by all the component individuals, and hence the aggregation process will become increasingly difficult.

As one might expect, there is a great range in the magnitude of discontinuities between groups of individuals. On the one hand, we have the situation which exists in the maidenhair tree (*Ginkgo biloba*), in which the plants are so unlike anything else that they constitute a distinct order, yet they are at the same time so much alike that all the individuals are commonly referred to one species. On the other hand, we have the situation which exists in the genus *Salix*, the willows. Here, many of the species of the northwestern United States are all capable of interbreeding to produce fertile offspring. If we wish to argue that species have an objective reality, we may select examples such as *Ginkgo*. If we wish to argue that species do not exist in nature at all, we may select such examples as the willows. A true understanding of the situation in nature, however, must embrace both of these extreme cases.

There is sufficient discontinuity apparent in nature to retain the term "species" as a convenient designation, provided that the user and listener is each cognizant of the significance of its use. While the individuals which comprise the species are aggregated on the basis of their common characters, it must be recognized that these individuals can be assumed to be alike only in these determined respects. In any other character, variation should be expected until constancy is demonstrated. We must be forever conscious of the fact that a species is not a homogeneous group of identical individuals, but, on the contrary, within a species variation is more common than constancy.

Since the list of characters common to the individuals of a species is compiled by various workers, and since these workers usually select different samples, the lists of common characters are necessarily subjective. Also, since the characters of the species are nothing more or less than the list of common characters, it would appear that the species itself is merely a mental aggregation of the individuals bearing these characters.

This does not deny the existence of species, but indicates that they are mental units rather than biological units. The biological units are the individuals and these functioning individuals are interrelated through their phylogenetic lineages. We have a hierarchy of categories set up by international agreement through which we may express our concepts of these relationships. The more minor the category selected to embrace two individuals, the closer is the suggested relationship. Thus two individuals in the same *forma* are presumed to be more closely related than they would be if placed in different *forma* in the same variety; and the

latter would be more closely related than if they were placed in different varieties, or different species.

The question of paramount importance is "How are these individuals related," not "To what category should each be assigned?" If an analogy might be used, we could consider a river system. It matters little whether the tributaries are called creeks, runs, streams, rills, brooks, or rivers. The important aspect concerns their location, depth, breadth, and rate of flow. So with our plants, the "species problem" concerns not so much what constitutes a species, but rather, what are the attributes of the individuals included in each species. As our knowledge of these attributes grows, apparently conflicting evidence will tend to disappear, since there can be no conflict in truth, and a more accurate portrayal of relationships will be possible.

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APACHE PINE AND ITS RELATIONSHIP TO PONDEROSA PINE

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Righter and Duffield (1951) described a hybrid obtained by crossing ponderosa pine (*Pinus ponderosa* Laws.) and Apache pine (*P. latifolia* Sarg.). The hybrid possessed several advantageous characters, such as a long taproot and rapidity of growth. It appears to be interesting to inquire into the taxonomic status of the parents because their relationship is far from being settled.

Some botanists (Shaw, 1914, p. 66) consider the Apache pine of southwestern United States and Mexico merely a variety of ponderosa pine. From their point of view the hybrid *P. latifolia* $\times$ *P. ponderosa* is, then, the product of an intraspecific hybridization, i.e. hybridization of two varieties of the same species. Others (Sudworth, 1917, pp. 33–35) believe that Apache and ponderosa pines are distinct species; thus the hybrid should be considered, by those who share this opinion, as the result of a distant (interspecific) hybridization.

Ponderosa pine is a generally recognized species. The several varieties which have been described under it (such as var. *scopulorum* Lemmon or var. *nigricans* Lemmon) are considered valid by some botanists, while others do not believe that these entities merit varietal status. (*Pinus Jeffreyi* Grev. & Balf., at one time regarded as a variety of *P. ponderosa,* is now considered a distinct species by most workers.)